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From the Customer's Viewpoint**

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# Ship Conversion Project Monitoring - From the Customer's Viewpoint

VA-2

Edward S. Karlson, Member, Maritime Administration

## ABSTRACT

Over the past ten years, the Maritime Administration (MARAD) has awarded and administered contracts for the major conversion of 15 vessels. Each of these projects involved vessel reactivation as well as conversion, and each contract was awarded on a fixed price basis.

The combination of fixed pricing and vessel conversion/reactivation creates a challenge to shipyards bidding for the contract in that price competition is intense while, at the same time, an unknown level of growth work can be expected in the vessel reactivation portion of the project. Moreover, the project being bid, inclusive of anticipated growth work, must be integrated into the overall orderbook within the shipyard. The need for careful planning by the shipyard from the beginning of bid preparation through the end of the performance period is clearly evident.

This SNAME paper, however, addresses not shipyard planning but continuing project monitoring and progress evaluation by the shipyard's customer. Such monitoring includes ongoing comparisons between the shipyard's planned and actual performance with respect to resource application and schedule adherence. From a technical standpoint; it involves compliance with contract and specification requirements. And finally, from a financial standpoint, it includes project progressing to provide the basis for periodic payments to the shipyard for completed work.

## INTRODUCTION

The shipyard's plan for completing a major conversion/reactivation project on time and within budget involves integration of the project into other orderbook work, timely accomplishment of necessary engineering, timely procurement and receipt of material,

allocation of facilities and financial resources, and time-phased allocation of labor resources.

The customer's plan for monitoring a major conversion/reactivation project, on the other hand, must be essentially complete before the project is even bid because the solicitation must include all of the project monitoring considerations which the shipyard will be required to comply with. Fundamental among these considerations is the requirement for submission of specified information by the shipyard to the customer prior to contract award and throughout the contract period. This paper focuses on these information requirements without which effective contract monitoring and progress evaluation cannot be accomplished, even though inspection of in-process work may be satisfactory.

Successful completion of a major conversion/reactivation project in accordance with contractual provisions is a team effort. It is important that both the shipyard's plan and the customer's plan be accommodated within this effort.

## PRECONTRACT CONSIDERATIONS

### Pro Forma Contract Provisions

MARAD includes a pro forma contract in its bid solicitation which includes several basic requirements to assist in project monitoring and progress evaluation. Among these requirements are:

Inspection. The shipyard is required to provide specified facilities, materials and services necessary for the safe and convenient on-site administration of the contract. A MARAD Construction Representative is assigned the responsibility and authority to conduct ship and work site inspection and to accept shipyard work. All workmanship and materials, and all shipyard operational practices, are

required to be in accordance with the requirements of specified regulatory and other rule-making bodies. The vessel must be fully certified by the U.S. Coast Guard and the American Bureau of Shipping prior to MARAD acceptance for redelivery. In the event that vessel performance during specified dock and sea trials is unacceptable, the equipment in question is required to be opened for post-trial inspection and any defects for which the shipyard is responsible shall be corrected.

Information. At the beginning of the project performance period, the shipyard is required to submit a summary cost estimate and certain other cost data which are needed to establish an acceptable system of progress payments to the shipyard. This system of progress payments is addressed in greater detail later in the paper.

During the project performance period, the shipyard is required to provide all plans, schedules, documents and other information as specified in the plan and correspondence procedure which is also addressed in greater detail later in the paper.

Growth Work. There are two types of growth work in a MARAD contract for vessel major conversion/reactivation. The first applies to changes in contract requirements which may include changes in specified conversion work to be accomplished. The second applies to delivery orders for supplementary repair work. Whether for a change order or a delivery order, contractual procedures provide for full MARAD involvement in the technical identification and authorization of growth work. The process requires the shipyard to submit an estimate including labor hours, material quantities and cost, and an estimate of delay, if any.

The contract provision applicable to changes also addresses constructive changes and acceleration. The shipyard is required to provide written notice to MARAD if it believes MARAD has ordered such events.

Progress Reviews. The shipyard is required to conduct quarterly progress reviews for MARAD at the shipyard during which the categories of engineering, production, material procurement, logistics and outstanding contractual matters are addressed.

Monthly meetings between MARAD and the shipyard are also held at the shipyard during the in-between months to review physical progress of vessel conversion/reactivation.

Specifications. The contract specifications provided to the shipyard by MARAD address the technical aspects of the conversion/reactivation project. These specifications include additional requirements for additional information to be furnished by the shipyard which are addressed in greater detail later in the paper.

Basis of Contract Award. Of primary importance in the pro forma contract, from a project monitoring standpoint, is the provision which states that the contract will be awarded to that responsive and responsible bidder with the lowest total responsive bid and whose redelivery date does not exceed the contract redelivery date. The term "responsible" is key in that it mandates a determination of contractor responsibility by MARAD's contracting officer in accordance with the Federal Acquisition Regulation (FAR). FAR 9.104-1, General Standards, includes several specific requirements which a prospective contractor must meet to satisfy a favorable determination of responsibility. A pre-award survey is generally conducted by MARAD in order to assess whether these requirements are or can be met. The shipyard's plan for accomplishing the conversion/activation project is reviewed during the survey.

#### PRE-AWARD SURVEY

After bids are opened, MARAD contacts the apparent low bidder and then follows up with a letter confirming arrangements for the onsite pre-award survey and requesting the information included in Table I.

Latest audited financial statements and management letter from Certified Public Accountant firm

Completed MARAD information form (SF 17): Facilities Available for the Construction or Repair of Ships

Time-phased production workforce allocation plan (separate plans for conversion and reactivation/repair)

Preliminary key event schedule

Summary cost estimate and detail cost backup sheets

Vendor quotations for material, equipment and services exceeding \$10,000

Input for following pre-award survey forms:

SF 1403 (General)

SF 1404 (Technical)  
 Resumes of key personnel  
 Evaluation of technical capabilities  
 Description of technical capabilities which yard lacks

SF 1405 (Production)  
 Shipyard organization  
 Production control system  
 Plant facilities  
 Production equipment  
 Long lead procurements for project  
 Major subcontracting  
 Personnel  
 Delivery performance record  
 Related previous production (government)  
 Current production orderbook

SF 1406 (Quality Assurance)  
 Organization  
 Instructions/procedures

SF 1407 (Financial Capability)

SF 1408 (Accounting System)

Table I Precontract Information  
 from Apparent Low Bidder

The latest audited financial statements and management letter are needed to determine whether the bidder has or can obtain adequate financial resources to perform the contract.

The completed standard form SF-17 is needed to determine whether the bidder has or can obtain necessary production, construction, and technical equipment and facilities.

The time-phased production workforce allocation plan is needed to determine whether the bidder has, or can obtain, the necessary labor to perform the contract on a timely basis. Figure 1 is a typical workforce allocation plan which presents manhour loading by month and cumulative percent loading during the period when the vessel is in the yard. The fairly rapid buildup of manhours indicates that reactivation work commences at an early stage when engineering and material procurement for conversion work do not absorb a significant workforce. In Figure 1, the contract redelivery date is at the end of month 14.

The primary importance of Figure 1 from a project monitoring and progress evaluation standpoint is that it presents the shipyard's time-phased plan for allocating labor. Shipyard performance during the contract period is measured against this plan.

The preliminary key event schedule is needed to determine how the shipyard intends to approach the conversion/reactivation project. Will reactivation work be accomplished at the beginning, throughout or at the

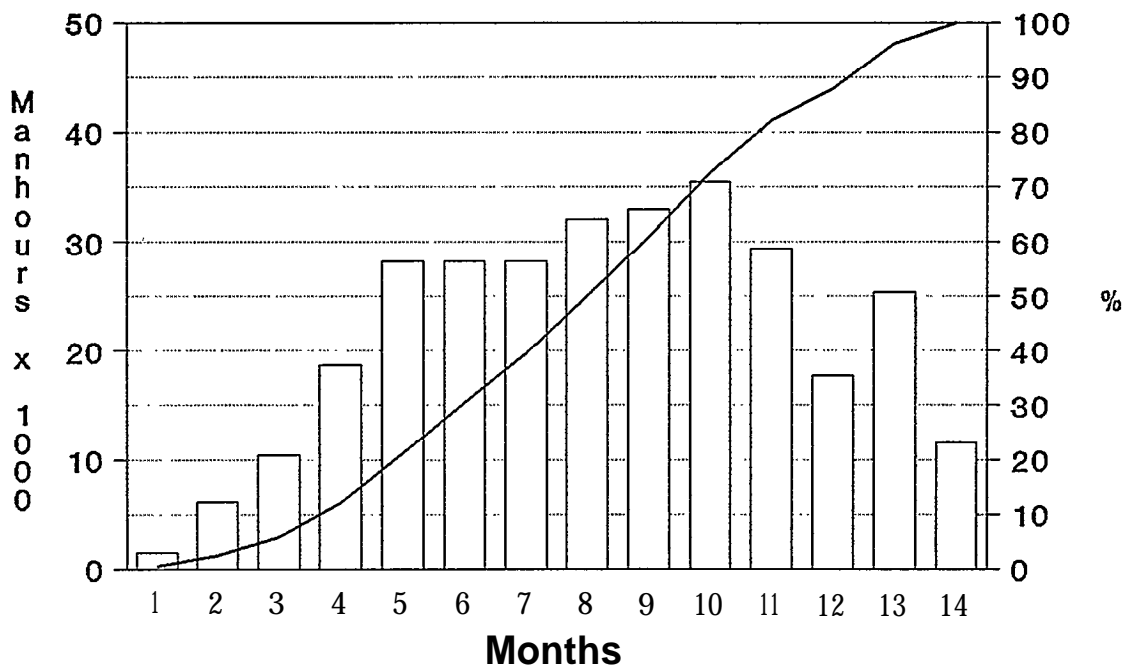


Figure 1 Time-Phased Production Workforce Allocation Plan  
 for Base Contract Work

end? How long is conversion engineering expected to take? What are the target dates for receiving major equipments? Has the shipyard left anything off the schedule which MARAD considers important? Has enough time been allotted toward the end of the contract period for testing and trials? Answers to these types of questions provide MARAD with the secondary benefit of information pertinent to timely assignment of inspectors to its field construction office at the shipyard.

The summary cost estimate., detail cost backup sheets, and major vendor quotations are specific pro forma contract requirements. Although the shipyard is not obligated to furnish them prior to contract award, they do facilitate an effective pre-award survey and determination of responsibility.

The pre-award survey team must provide a complete survey inclusive of recommendations, to the contracting officer. This report is in the five sections indicated in Table I by the "standard form" (SF) identifiers. MARAD forwards blank forms to the shipyard prior to the survey and requests that appropriate information on the forms be completed to the maximum extent possible, and that the partially complete forms be returned to MARAD for review prior to the pre-award survey.

Thus far, this paper has addressed precontract considerations which impact on project monitoring. They provide a framework of requirements which the shipyard must comply with and a basic shipyard plan on how the work will be accomplished. The next section of the paper addresses post contract considerations which address information requirements provided for in the pro forma contract and contract specifications but which apply to the shipyard during the contract period.

#### POST CONTRACT CONSIDERATIONS

Table II is a list of information requirements in eleven specific areas

which, in aggregate, provide ongoing project monitoring information as work is being accomplished. All of these requirements are addressed in the plan and correspondence procedure which is an integral part of the pro forma contract.

#### Production schedules:

##### Key event schedule

Master production schedule  
(Including material ordering schedule and test schedule)

##### Tank open and inspect schedule

##### Working plan schedule and plans

##### Purchase specifications

Equipment technical manuals and engineer's operating manual

##### Force reports

##### Progress photographs

##### Construction progress and payment report

Receipts for contractor-furnished and government-furnished material

Logistic support plan and schedule (including existing ship's inventory and condition report)

##### Test memoranda

Equipment and system technical reports as required by contract specifications

#### Table II Post Contract Information from Shipyard

#### Plan and Correspondence Procedure (P&CP)

Under the plan and correspondence procedure, the shipyard is required to provide a master production schedule and key event schedule (Figure 2) to MARAD within 45 days after contract award, and to update and reissue these schedules on a monthly basis.

Item No.	Item Description	<u>Planned</u>		<u>Revised</u>		<u>Actual</u>	
		<u>Start</u>	<u>Finish</u>	<u>Start</u>	<u>Finish</u>	<u>Start</u>	<u>Finish</u>
	Key Events			20-30	Items		
	Conversion			50-100	Items		
	Reactivation/Repair			50-100	Items		

Figure 2 Key Event and Master Production Schedules

The master production schedule is required to identify all engineering and production activities which impact on project scheduling. It generally includes 100 to 200 line items and is in sufficient detail so that critical path(s) to project completion can be identified. The format for both the master production schedule and key events schedule includes baseline (originally planned), revised estimate (schedule slippage in excess of 15 days), and actual start and finish dates. The data in these two schedules provide the primary basis for ongoing monitoring of production schedule progress and for review of production activity and problems at the quarterly and monthly progress meetings.

Because most of the vessels in MARAD major conversion/reactivation projects are in excess of 20 years old, the condition of their tanks is often suspect. Accordingly, a separate "open and inspect" schedule for all deep tanks, double bottom tanks, peak tanks; cofferdams, cargo tanks and any other tanks subject to regulatory body inspection is required to be submitted within 45 days after contract award. The schedule must be developed to ensure that all tanks are opened and inspected in sufficient time for all repairs to be identified, priced and submitted to MARAD for action within eight months after ship availability.

A working plan schedule is required to be originally issued within 60 days after contract award and reissued thereafter with updates on a monthly basis. MARAD approves all shipyard working plans. Those that are approved at the headquarters level must be turned around with 20 days; those at the field construction office level within 8 days. This ongoing plan approval process affords a good opportunity to monitor engineering progress and its impact on production.

Purchase specifications are required to be included in a material control schedule and are subject to the same MARAD approval process as shipyard plans. This ongoing purchase specification approval process affords a good opportunity to monitor material procurement progress and its impact on production.

New equipment technical manuals, reworked portions of existing equipment technical manuals and updated portions of the engineer's operating manual are all subject to approval by MARAD.

Figure 3 is a typical force report required by the plan and correspondence procedure to be submitted on a monthly basis.

In this report, the shipyard is required to include shipyard hours expended during the month just ended for both base contract work and growth work. The cumulative hours expended since contract award and expected hours at project completion for both of these categories must also be included. The total number of shipyard employees is included to provide a means to approximate the percentage of shipyard labor resources being expended on the conversion/reactivation project. For project monitoring and progress evaluation purposes, the monthly force reports provide actual labor expenditure data for measurement against planned labor expenditure data.

To assist in project monitoring, a minimum of five photographs are required to be submitted on a monthly basis. The five photographs include two to indicate overall views of the entire weather decks and superstructure and at least three, as selected by the shipyard, to indicate significant progress or status for specific items during the reporting month.

<u>Manhours Expended</u>		<u>Current Month Cumulative</u>	
Base Contract Work		26,253	171,239
Change Orders/Delivery Orders		<u>4,791</u>	<u>35,688</u>
Totals		31,044	206,927
<u>Estimated Manhours at Completion</u>			
Base Contract Work			306,000
Change Orders/Delivery Orders			<u>50,000</u>
Total			356,000
<u>Total Number of Employees</u>			724

Figure 3 Force Report (End of Month 10)



Under MARAD contracts for major conversion/reactivation projects, progress payments are made to the shipyard in accordance with physical progress achieved based on a 10,000 point system representing material and labor value components for specified work. Figure 4 is a typical contract progress certification system in which aggregate material accounts for 40 percent (4,000 points) of the contract value for base contract work and labor accounts for 60 percent (6,000 points).

The system typically includes up to approximately 20 line items in the general category for cost accounts such regulatory bodies, towing, performance bond, tests, trials, general services, engineering, etc. From 50 to 100 lines items are usually included in conversion cost accounts and from 150-200 line items are usually included in reactivation/repair cost accounts. The up-to-ten line items in major material procurements/subcontracts cost accounts occur when material suppliers or subcontractors require progress payments. These are "material" costs to the shipyard and MARAD does not pay progress for material until it is received at the shipyard unless special arrangements are made on a line item basis. These special arrangements permit progress payments for offsite work.

In Figure 4, the aggregate material completion percentage is 70.0 and the aggregate labor completion percentage is 45.2 yielding a base contract work completion percentage of 55.12 for the project. Subtraction of

the previous time period completion percentage provides an incremental progress increase which when multiplied by the base contract price yields the progress payment value for the current partial payment period. For project monitoring and progress evaluation purposes, the labor progress date is particularly important throughout the project for measuring against manhour expenditures, and toward the end of the project when monitoring efforts focus on work yet to be accomplished.

Progressing of growth work is separately handled on a line item basis. A change order or delivery order must be settled as to price before any MARAD payment for it is made. For a change order/delivery order settled for more than \$50,000, a MARAD payment can be made based-on the percent of work complete. Figure 5 is a typical change order/delivery order status report maintained by MARAD's onsite construction representative to, in part, assist in progressing growth work.

In Figure 5, the price for the lifeboats line item is settled so partial progressing can occur before the work is complete. Progressing at 100 percent for the radar line item can also occur because the work was completed on 11-3-89. For project monitoring purposes, the data in Figure 5 are particularly useful for keeping track of growth work line items in the administrative process from identification to approval. For major conversion/reactivation projects, the number of growth work line items

Item No.	Item Description	<u>Material</u>			<u>Labor</u>			<u>Total</u>	
		Point Value	% Comp.	Value Comp.	Point Value	% Comp.	Value Comp.	Point Value	Value Comp.
	General				20		Items		
	Conversion				50-100		Items		
	Reactivation/Repair				150-200		Items		
	Major Material Procurements/ subcontracts				10		Items		
Contract Totals		4,000	70.0	2,800	6,000	45.2	2,712	10,000	5,512
					<u>Agreed</u> <u>Price</u>	<u>%</u> <u>Comp.</u>	<u>Payable</u> <u>Amount</u>		
	Change Orders/Delivery Orders (\$50,000 or Less)				\$ 34,500	100	\$34,500		
	Change Orders/Delivery Orders (Exceeding \$50,000)				\$134,000	40	\$53,600		

Figure 4 Contract Progress Certification system

CO/DO No	Title	Estimated cost	CR Submittal Date	CO/DO Approval Date	yard Item No .	Price Settlement Date	Settled Price	Work Completion Date
001	Lifeboats	\$57,250	2-1-89	2-17-89	416	3-14-89	\$53,198	
347	Main Circ. Pump	4,729	8-23-89	9-2-89				
491	Radar	8,118	9-22-89	9-23-89	506	9-23-89	7,793	11-3-89

Figure 5 change Orders/Delivery orders status Report

typically exceeds 700.

To assist MARAD's construction representative in progressing the material portion of line items in Figure 4 and in generally monitoring the receipt of material for production support purposes, the shipyard is required to provide MARAD with warehouse receipts for both contractor-furnished and government-furnished material.

Contract specifications for major conversion/reactivation projects require a significant shipyard effort in the area of logistics. Specific efforts include existing vessel inventory, spare parts procurement, loose item outfitting procurement, packaging/ labeling, onboard stowage, equipment validation, equipment technical manuals, etc. The shipyard is required to provide a logistic support schedule in the same format as Figure 2 (key event and master production schedules). For project monitoring purposes, the data in the logistic support schedule are particularly useful in assessing progress toward logistics completion at vessel redelivery.

Test schedules and test memoranda are required to be provided by the shipyard. MARAD approval of test memoranda is coordinated at the field construction office level. Since testing and trials essentially constitute the final segment of project inspection, the thorough and timely preparation of test memoranda is an important element of project monitoring.

The final item under the plan and correspondence procedure being addressed in this paper is the requirement for the shipyard to provide variety of equipment and system technical reports addressed in contract specifications. These reports include equipment condition reports, tank

sounding reports, bearing clearance reports, cathodic protection reports, motor and generator megger reports, lube oil quality reports, etc. All of these reports assist MARAD's construction representative monitoring the project from the standpoint of inspection and need for specific growth work.

#### INSPECTION AND EVALUATION

##### Onsite Inspection

MARAD contracts for vessel major conversion/reactivation invoke FAR clauses 52.246-4 and 52.246-6 which, in turn, are based on FAR subpart 46.202-2, Standard Inspection Requirements, under FAR subpart 46.2, Contract quality Requirements. Subpart 46.202-2 states that the invoked clauses:

- "(1) Require the contractor to provide and maintain an inspection system that is acceptable to the Government;
- (2) Give the Government the right to make inspections and tests while work is in process; and,
- (3) Require the contractor to keep complete, and make available to the Government, records of its inspection work." (1)

Element (2) above and MARAD's contract progress certification system provide the cornerstones for MARAD's onsite inspection program regarding work in process. These cornerstones are supplemented by specific contract provisions and contract specification requirements. To assure compliance with contract/specification requirements, a MARAD field construction office is established at the shipyard and headed by a MARAD

construction representative. This construction representative has specified contract responsibilities and authorities and is supported by an inspection staff. The inspection staff includes an office manager and combinations of inspectors to perform hull, machinery, electrical and logistics inspection duties.

MARAD's construction representative and inspection staff constitute MARAD's primary means of project monitoring for work in process.

#### Progress Evaluation

Whereas onsite inspection applies to work in process, progress evaluation applies to overall contractual performance which is essentially accomplished at MARAD's headquarters level.

Figure 6 is a set of curves applicable to the time-phased expenditure of production labor for base contract work. The data points in the curves are consistent with data presented in Figures 1, 3 and 4. The vessel availability curve is simply a straight line projection of the vessel's availability for accomplishment of base contract work from arrival at the shipyard through

the contract redelivery date. The planned production labor expenditure curve is taken directly from Figure 1 which was provided by the shipyard to MARAD in connection with the pre-award survey. A variation of these data would be splitting the curve into two curves; one for vessel conversion and one for vessel reactivation. The actual production labor expenditure curve is taken from Figure 3, the series of which provide manhour expenditure data on a monthly basis. Bid labor hours for base contract work is the 100 percent data point for manhours. Although generally not necessary for normal progress evaluation purposes, the percent actual production labor expenditure monthly data points may be adjusted to reflect the estimated manhours at completion for base contract work in Figure 3 rather than bid manhours. For example, if the shipyard decides to "buy" a substantial amount of work it intended in its bid to accomplish with shipyard labor or if a serious overrun of labor hours is emerging, the 100 percent data point for manhours could significantly change and a recalculation of previous data point values may be needed for effective progress evaluation. The labor progress curve is taken from Figure 4, the series of which provide the required labor data.

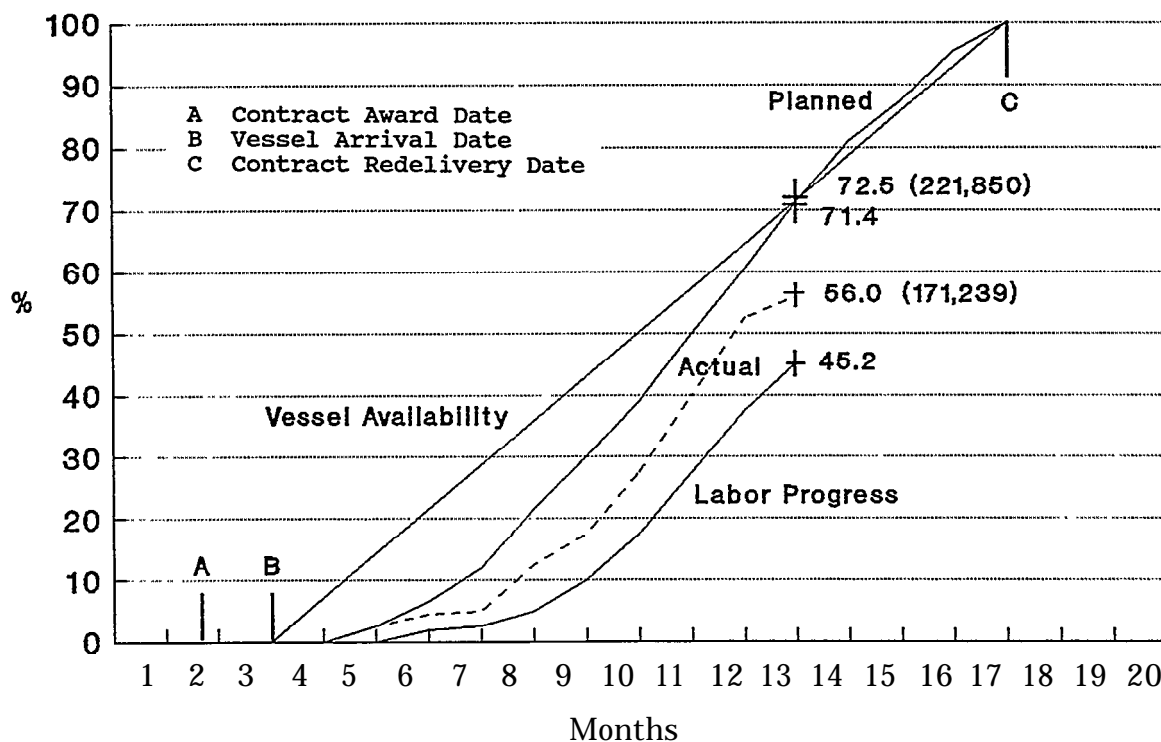


Figure 6 Time-Phased Production Labor Expenditures for Base Contract Work

The data in Figure 6 indicate that, as of month ten (13 minus 3), the following percentages apply:

Item	%	Manhours
Planned labor expenditure	72.5	221,850
Vessel availability	71.4	--
Actual labor expenditure	56.0	171,239
Labor progress	45.2	--

It is not possible to reach absolute conclusions from simplistic comparisons among the above data. It is possible, however, to identify trends and to suggest that specific possibilities should be examined in more detail. For example, actual labor expenditures lagged planned labor expenditures as of the end of month ten by 16.5 percent and divergence is evident. IS the project being undermanned? Has significant shipyard work been diverted to subcontract work? Should project manning be increased at this time? As another example, labor progress lagged actual labor expenditures as of the end of month ten by 10.8 percent. Is the shipyard

underprogressing from a labor standpoint? Is labor productivity less than it should be? Are hours being charged to this project that should not be? The worst case being suggested by the Figure 6 data is one of labor undermanning coupled with less than acceptable labor productivity. This may not be true but questions should be asked by both shipyard management and its customer, and answers should be found.

Figure 7 is the Figure 6 data extended to vessel redelivery with Case 1 reflecting a labor underrun and Case 2 a labor overrun. At this point in time, of course, we are no longer monitoring the project or evaluating progress but are assessing why the vessel was redelivered 80 days late and what happened to the manpower loading.

The data in Figure 7 indicate that, as of vessel actual redelivery, the following percentages applied:

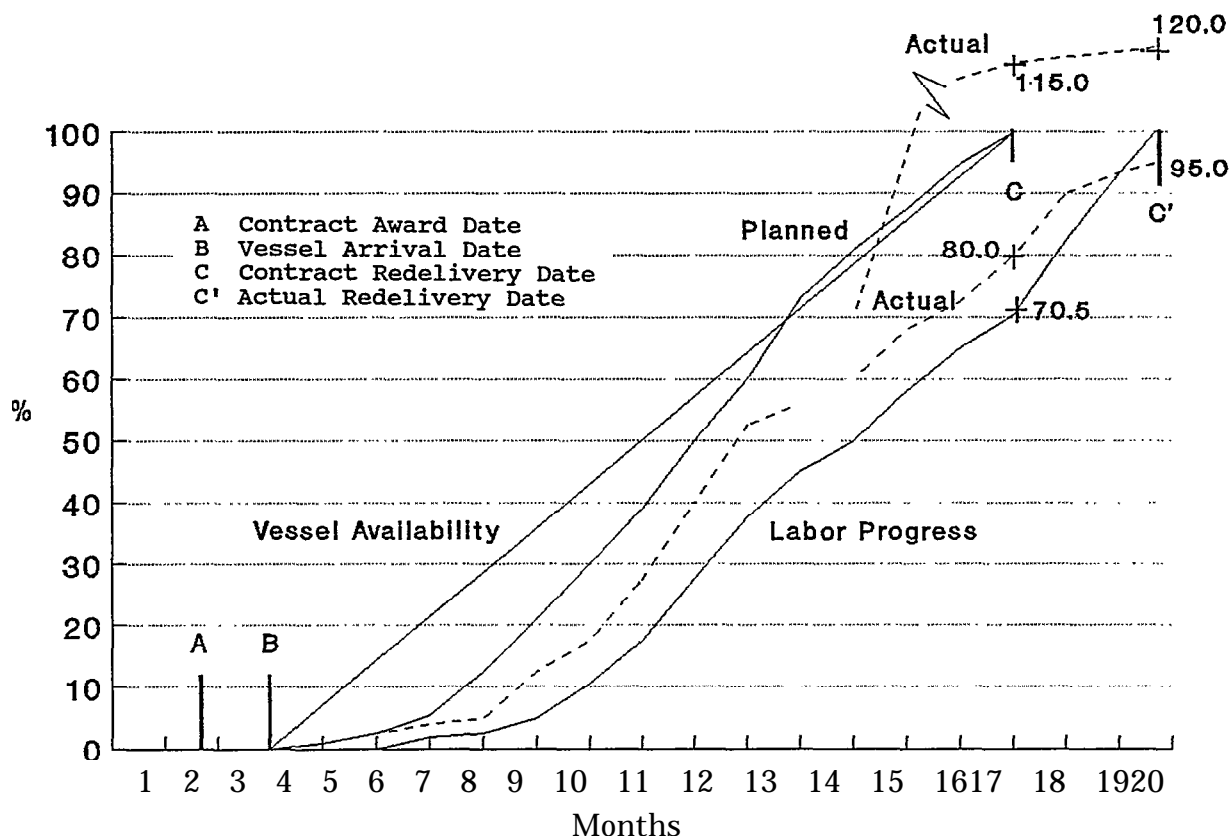


Figure 7 Time-Phased Production Labor Expenditures for Base Contract work - Delay

Item	Case 1 %	Case 2 %
Planned labor expenditure	100.0	100.0
Vessel availability	--	--
Actual labor expenditure (as of contract redelivery date)	80.0	115.0
Actual labor expenditure (as of actual redelivery date)	95.0	120.0
Labor progress	100.0	100.0

Again, it is not possible to reach absolute conclusions from the above data or from comparisons among these data. It is possible, however, to suggest that specific possibilities should be examined in more detail. For example, in Case 1, the actual expenditure of labor as of vessel actual redelivery was only slightly less than the planned expenditure; but the actual expenditure was only 80.0 percent as of the contract redelivery date. Was the project undermanned causing delay? Was the delay caused by growth work in lieu of base contract work? Was the delay the responsibility of the customer? Were portions of the contract specifications defective? In Case 2, the actual expenditure of labor as of vessel actual redelivery was significantly greater than the planned expenditure. In fact, the actual expenditure was already 15 percent higher than 100 percent of the planned expenditure as of the contract redelivery date. In addition to the above questions, was there poor labor productivity particularly toward the end of the project? Was there substantial disruption and inefficiency due to growth work? Is there a basis for shipyard submission of a request for equitable adjustment to the customer? Should shipyard labor data bases be updated for future bidding purposes?

#### SUMMARY

As stated in the Abstract, the combination of fixed pricing and vessel conversion/reactivation creates a challenge to shipyards bidding for the contract in that price competition is intense while, at the same time, an unknown level of growth work can be expected in the vessel reactivation portion of the project. This challenge also extends to the customer whose primary objective is project completion within budget, on time and in compliance with specification and approved growth work requirements. To achieve this objective, the customer should include sufficient provisions and requirements in the contract and

contract specifications to assure an opportunity to effectively monitor the project and to evaluate progress during the period of performance. This paper has presented actions taken by the Maritime Administration to help assure that its project monitoring and progress evaluation processes are effective.

#### REFERENCE

1. Federal Acquisition Regulation (FAR) subpart 46.2, Contract Quality Requirements

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